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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER				
SYKES, ALTREV C				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/540,231

Applicant(s)

YAMANAKA ET AL.

Examiner

ALTREV C. SYKES

Art Unit

1794

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 65-129 is/are pending in the application.
- 4a) Of the above claim(s) 84-129 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 65-83 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. ____.
 - ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SF/ICE)
Paper No(s)/Mail Date 20050621
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date ____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: ____

DETAILED ACTION

Election/Restrictions

1. Applicant's election of Group I, claims 65-83 in the reply filed on April 18, 2008 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)). Claims 84-129 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected Groups II-V, there being no allowable generic or linking claim.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
3. Claims 66 and 69 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 66, it is unclear to examiner whether applicant is requiring the substitution of an aluminum template or only that the structure be capable of having that substitution. As such, for examination purposes at this time, examiner will treat the limitation to mean that the nanostructure is capable of such a substitution.

Regarding claim 69, it is unclear to examiner how aluminum oxide is to be incorporated into the nano-structure of claim 65 of which it depends. As noted by claim 65, the metal complex ion would be formed of the groups therein listed which do not include aluminum as a choice. For examination purposes at this time, examiner will

consider that applicant is meaning to rely on the aluminum template substitution of claim

66. As such, claim 69 should depend from claim 66 and not claim 65.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. Claims 65, 66, 68-70 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kasuga et al. (US 6,027,775).

Regarding claim 65, Kasuga et al. discloses crystalline titania of which the crystal shape is a novel nanostructure of a nanotube. (See Abstract) Examiner notes titania to be equivalent to titanium oxide. Additionally, as noted in the previous office action mailed March 18, 2008, it is noted by examiner that based on Applicant's disclosure, titanium oxide meets the recitation of the invention being able to form a complex with a fluoride

complex ion. (See Applicant Specification [0031] and [0037]-[0039]) It is reasonable to presume that ability to compose a fluoride complex ion is inherent to Kasuga et al. Support for said presumption is found in the use of like materials and/or like methods (i.e. the metal element is one of transition metal elements, group IA elements, group IIA elements, group IIIB elements, group IVB elements, group VB elements and group VIB elements, and the metal element) which would result in the claimed property. The burden is upon the Applicant to prove otherwise. *In re Fitzgerald* 205 USPQ 594. In addition, the presently claimed properties would inherently have been present once the Kasuga et al. product is provided. Note *In re Best*, 195 USPQ at 433, footnote 4 (CCPA 1977). Further, it is noted by examiner that applicant discloses the stability constant refers to a measure representing stability of the complex in a solution. (See Applicant Spec [0011]) As such, it would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the stability constant since it has been held that, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). The burden is upon the Applicant to demonstrate that the claimed stability constant is critical and has unexpected results. In the present invention, one would have been motivated to optimize the stability constant motivated by the desire to provide a specifically tailored the nano-structure based on end product use. Additionally, examiner notes that the Stability Constant, K_{stab} , is the equilibrium constant for the equilibrium that exists between a transition metal ion surrounded by water molecule ligands and the same transition metal ion surrounded by

ligands of another kind in a ligand displacement reaction. Since for a given transition metal ion, the different types of ligands always displace water molecule ligands in the equilibrium reaction, the numerical values can be used to decide upon the order in which the ligands are stabilizing a particular transition metal ion. The higher the value of the stability constant, the more stable the complex. (via known Physical Chemistry) Therefore, the modification would have been well within the skill of one in the art at the time of the invention.

Regarding claim 66, the limitation is interpreted by examiner to mean that the substitution can be done and is not actually is required to be done. Therefore, the structure as disclosed by Kasuga et al. would also be capable of the substitution as claimed by applicant.

Regarding claim 69, Kasuga et al. discloses all of the claim limitations as set forth above but the reference does not specifically disclose wherein aluminum oxide remains in an amount of 0.1 volume% or more, relative to the total oxide. As it has been concluded above that the substitution of an aluminum template with the fluoride complex ion would have been inherently capable in the Kasuga et al. structure, examiner now finds that the amount of aluminum oxide relative to the total oxide would have been obvious to one of ordinary skill in the art at the time of the invention. The modification would have been motivated by the desire to tailor the final nano structure for its various end uses.

Regarding claim 68 examiner notes that the titania powder of Kasuga et al. is equivalent to the fine particles of metal claimed by applicant.

Regarding claim 70, absent a showing to the contrary, it is the examiner's position that the article of the applied prior art is identical to or only slightly different than the claimed article. Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process. *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985). The burden has been shifted to the applicant to show unobvious difference between the claimed product and the prior art product. *In re Marosi*, 218 USPQ 289 (Fed. Cir. 1983). The applied prior art either anticipated or strongly suggested the claimed subject matter. It is noted that if the applicant intends to rely on Examples in the specification or in a submitted declaration to show non-obviousness, the applicant should clearly state how the Examples of the present invention are commensurate in scope with the claims and how the Comparative Examples are commensurate in scope with the applied prior art. In the instant case, Kasuga et al. discloses the crystalline titania which has a nanotube shape in the present invention is produced by treating a titania powder with an alkali. (See Col 2, lines 23-25) Examples thereof include titania powders produced from a titanium ore such as anatase, rutile, brookite and the like by the following known liquid phase method, vapor deposition method or sol-gel method. (See Col 2, lines 30-47) In the alkali treatment, a titania powder is dipped in from 13 to 65% by weight of sodium hydroxide at a temperature of from 18 to 160.degree. C. for from 1 to 50 hours. (See Col 2, lines 49-51)

The alkali treatment includes a step of water-washing as a final step. It is advisable to neutralize the resulting product with an inorganic acid such as dilute hydrochloric acid or the like. (See Col 3, lines 15-18) The above-obtained nanotube titania may further be heat-treated to improve the crystallinity and to increase the catalytic activity. (See Col 3, lines 20-25)

7. Claim 67 is rejected under 35 U.S.C. 103(a) as being unpatentable over Den et al. (US 6,804,081).

Regarding claim 67, Den et al. discloses a nano structure having pores includes a first layer containing alumina, a second layer that includes at least one of Ti, Zr, Hf, Nb, Ta, Mo, W and Si, and a third layer with electrical conductivity, in this order, wherein the first and second layers have pores. (See Abstract and Col 1, lines 20-25) As such, the structure is considered stacked. Den et al. also discloses the first layer is, for example, a layer obtained by anodically oxidizing material containing aluminum as a composition element. When the parts material is aluminum, the first layer may be an alumina layer (or, alumina nanohole layer). Naturally, the parts material may contain other elements if it has aluminum as its main composition ingredient. Main ingredient means the main element that comprises the parts material. The atomic weight ratio of the ingredient (i.e. aluminum) may be 20% or more in the aforementioned parts material. (See Col 4, lines 7-17) The second layer (i.e. bonding layer) is a layer obtained by anodically oxidizing material containing at least one of Ti, Zr, Hf, Nb, Ta, Mo, W and Si, like in the case of the first layer. The material mentioned above may be metal, semiconductor or alloy. Also, if the material is processed by anodic oxidation and becomes oxidized, such as

oxidized tungsten (W), this would be desirable. It is noted by examiner that oxidized tungsten would be the equivalent of a second oxide or complex oxide.

It is noted by examiner that based on Applicant's disclosure, titanium oxide meets the recitation of the invention being able to form a complex with a fluoride complex ion. (See Applicant Specification [0031] and [0037]-[0039]) It is reasonable to presume that ability to compose a fluoride complex ion is inherent to Den et al. Support for said presumption is found in the use of like materials and/or like methods (i.e. the metal element is one of transition metal elements, group IA elements, group IIA elements, group IIIB elements, group IVB elements, group VB elements and group VIB elements, and the metal element) which would result in the claimed property. The burden is upon the Applicant to prove otherwise. *In re Fitzgerald* 205 USPQ 594. In addition, the presently claimed properties would inherently have been present once the Den et al. product is provided. Note *In re Best*, 195 USPQ at 433, footnote 4 (CCPA 1977). The modification to utilize a metal element other than aluminum in the first layer would have been well within the ordinary skill of one in the art since Den et al. discloses that other elements may be contained in the first layer. (See Col 4, lines 7-17) Also, Den et al. discloses that both the first and second layers would contain anodically oxidizing material. A prima facie case of obviousness exists because aluminum is still a metal element although not one particularly claimed by applicant and would have required only routine experimentation to switch one metal for another.

Further, it is noted by examiner that applicant discloses the stability constant refers to a measure representing stability of the complex in a solution. (See Applicant

Spec [0011]) As such, it would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the stability constant since it has been held that, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). The burden is upon the Applicant to demonstrate that the claimed stability constant is critical and has unexpected results. In the present invention, one would have been motivated to optimize the stability constant motivated by the desire to provide a specifically tailored the nano-structure based on end product use. Additionally, examiner notes that the Stability Constant, K_{stab} , is the equilibrium constant for the equilibrium that exists between a transition metal ion surrounded by water molecule ligands and the same transition metal ion surrounded by ligands of another kind in a ligand displacement reaction. Since for a given transition metal ion, the different types of ligands always displace water molecule ligands in the equilibrium reaction, the numerical values can be used to decide upon the order in which the ligands are stabilizing a particular transition metal ion. The higher the value of the stability constant, the more stable the complex. (via known Physical Chemistry) Therefore, the modification would have been well within the skill of one in the art at the time of the invention.

8. Claims 71-76 and 80-83 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kasuga et al. (US 6,027,775) as applied to claim 65 above, in view of Iwasaki et al. (US 6,525,461)

Regarding claims 71-75 and 81-82 Kasuga et al. discloses all of the claim limitations as set forth above but the reference does not specifically disclose the nano-structure is a nano-hole array wherein nano-holes which have penetrating pores of 50 μ m or more are arranged like a bundle. However the reference does disclose the nanotube titania can be used in such applications as a filter; a material with a new performance which is obtained by inserting an organic, inorganic, or metal material therein; and a magnetic substance with new magnetic properties which is obtained by inserting a magnetic material therein. (See Col 3, lines 40-45)

Iwasaki et al. discloses narrow titanium-containing wire and the nanostructure to which the narrow titanium-containing wire is applied is produced by forming a porous layer having narrow pores on a substrate having a titanium-containing surface and forming narrow titanium-containing wires in the respective narrow pores by carrying out a heat treatment under a specific atmosphere. (See Col 5, lines 1-5) Iwasaki et al. illustrates in FIG. 3B a nanostructure composed of a substrate 10 having a layer 11, which constitutes a titanium-containing surface formed thereon, a porous layer (porous alumina) 13 provided on the surface that has narrow pores 14 extending vertically to the surface, and the narrow titanium-containing wires 15 being arranged in the respective narrow pores 14. (See Col 5, lines 14-21) The narrow titanium-containing wires 15 are formed of a metal, semiconductor or insulator comprising titanium as a main component, for example, any of titanium, titanium alloys, including titanium-iron and titanium-aluminum, and optional titanium compounds such as titanium oxide, titanium hydride, titanium nitride and titanium carbide. (See Col 5, lines 21-28) The porous alumina 13 is

composed mainly of Al and O, and many cylindrical and linear narrow pores 14 thereof are arranged substantially vertically to the surface of an aluminum film (plate) 601. The respective narrow pores are arranged at substantially regular intervals parallel to each other. (See Fig. 6 and Col 5, lines 60-65) The use of porous alumina as a base is preferable in semiconductor processing because a nanostructure can be easily produced over a large area under good control. (See Col 2, lines 45-48) As such, the pores are arranged like a bundle on a substrate. Iwasaki et al. further discloses such a narrow titanium oxide wire having excellent crystallinity can be expected to have good electrical properties and electron-emitting properties as a semiconductor. (See Col 8, lines 43-45)

Iwasaki et al. fails to teach pores of 50 μ m or more or that the aspect ratio is 100 or more. The reference also fails to teach length of the nano-hole is 1 μ m or more and the aspect ratio is 5 or more. However, the reference does disclose the diameter of the narrow pore is about 5 nm to 500 nm. (See Col 5, lines 66-67) It would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the diameter, length, and aspect ratio since it has been held that, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). The burden is upon the Applicant to demonstrate that the claimed diameter and aspect ratio are critical and has unexpected results. In the present invention, one would have been motivated to optimize the diameter, length, and aspect ratio motivated by the desire to control the final nanostructure product. Iwasaki et al. discloses the pore diameter may be controlled to some extent by various process

conditions such as the concentration and temperature of an electrolyte used in anodization, a method of applying anodizing voltage, anodizing voltage and time, and conditions of a subsequent pore widening treatment. (See Col 6, lines 1-6) Iwasaki et al. also discloses these narrow cylindrical pores 14 have a high aspect ratio and are excellent in linearity and uniformity of sectional diameter. (See Fig. 6 and Col 2, lines 2-11) It is noted by examiner that as the diameter of the nano-hole may be easily controlled, so would the length which would still be motivated by the desire to tailor the final nanostructure for semiconductor use.

As Kasuga et al. and Iwasaki et al. are both directed to nanostructures having improved crystallinity, the art is analogous. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize the nano-hole array of Iwasaki et al. for the added benefit of good electrical properties and electron-emitting properties as a semiconductor in the nanostructures of Kasuga. (See Col 8, lines 43-45)

Regarding claim 76, Iwasaki et al. discloses no particular limitation is imposed on the substrate 10 having the titanium-containing surface, so long as it contains titanium on the surface. Examples thereof include plates of titanium or an alloy thereof and substrates composed of any of various kinds of bases 16 such as quartz glaze and Si and a Ti-containing film 11 formed on the base. (See Col 6, lines 48-53) The Al-containing film 12 is subsequently anodized, thereby forming porous alumina 13 on the substrate (See FIG. 2C and See Col 6, lines 4-5) As the substrate surface contains titanium as well as alumina, the substrate is electrically conductive.

Regarding claim 80 and 83, it is noted by examiner that applicant defines a nano-needle as a nano-hole which is in a state separated from the nano-hole array and has a pore diameter of 10 to 500 nm by dissolution of the anodized alumina remaining on the circumference of the nano-hole array. (See Applicant Spec [0011] and [0018]). As such it is noted by examiner that modified Kasuga et al. discloses the claimed invention. Iwasaki et al. discloses the diameter of the narrow pore is about 5 nm to 500 nm. (See Col 5, lines 66-67) The Al-containing film 12 is subsequently anodized, thereby forming porous alumina 13 on the substrate (see FIG. 2C and See Col 6, lines 4-5) Therefore, examiner equates the nanostructures of Iwasaki et al. to be equivalent to the nano-hole and nano-needle of applicant.

9. Claims 77-79 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kasuga et al. (US 6,027,775) as applied to claim 65 above, in view of Lieber et al. (US 5,897,945)

Regarding claims 77-79 Kasuga et al. discloses all of the claim limitations as set forth above but the reference does not specifically disclose the nano-structure is a nanorod of oxide. However the reference does disclose the nanotube titania can be used in such applications as a filter; a material with a new performance which is obtained by inserting an organic, inorganic, or metal material therein; and a magnetic substance with new magnetic properties which is obtained by inserting a magnetic material therein. (See Col 3, lines 40-45)

Lieber et al. metal oxide nanorods and composite materials containing such nanorods. The metal oxide nanorods have diameters between 1 and 200 nm and aspect

ratios between 5 and 2000. (See Abstract) Lengths are generally greater than 1 μ m. (See Col 1, line 65) The nanorods have unique metallic, semiconducting, insulating, superconducting, optical or magnetic properties or combinations thereof. (See Col 3, lines 12-15)

As Kasuga et al. and Lieber et al. are both directed to metal oxide nanostructures, the art is analogous. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize the nanorods of Lieber et al. for unique metallic, semiconducting, insulating, superconducting, optical or magnetic properties or combinations thereof in addition to the nanostructures of Kasuga. (See Col 3, lines 12-15)

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Conclusion

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to ALTREV C. SYKES whose telephone number is (571)270-3162. The examiner can normally be reached on Monday-Thursday, 8AM-5PM EST, alt Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carol Chaney can be reached on 571-272-1254. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ACS/
10/7/08

/Carol Chaney/
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